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ABSTRACT: Within the purview of economics, there are a number of phenomena that remain unexplained. One such phenomenon is the existence of inter-industry wage differentials; differences in wages paid to observationally equivalent workers. This paper investigates the link between the degree of international competition in an industry and the premium paid to workers in that industry. The rationale for this connection lies in the hypothesis that the source of the observed wage premium arises from the sharing of rents with workers in profitable industries. International competition serves to reduce the market power of firms in the industry reducing the existence of rents, in turn, reducing the wage premium. It is in this sense that barriers to trade might result in a wage differential that would not otherwise exist.

Preliminary findings are that international competition does have a significant impact on both industry profitability and inter-industry wages. Further, the results indicate that the changes in competitiveness during the early 1980s altered industry wages differentials so as to *reduce* observed earnings inequality.

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I. Introduction

The origins of most modern studies of international trade and wages, both theoretical and empirical, can be traced to the pioneering work of Stolper and Samuelson (1941). This piece was the first to substantially tie down the general equilibrium relationship between changes in the international environment and relative factor incomes. In the subsequent fifty years, substantial effort has been devoted to generalizing this work theoretically and examining its validity empirically.

In recent years, awareness of the importance of international trade linkages with domestic wage determination has grown substantially. With increasing regularity, labor economists have begun including some measure of international trade in studies of wage determination. Deardorff and Hakura (1993) presents an excellent survey of this literature; including a very helpful discussion of the sizeable gap between the set of questions that can be appropriately asked and questions that are in fact asked.

The primary focus of the work to date has been on the general equilibrium effects of international trade on wage determination. Substantially absent from the literature is an analysis of partial equilibrium wage determination. While the perfectly competitive labor markets assumption standard in most of labor economics would indeed lead one to question such an analysis, much more than casual empiricism reveals its importance. The existence of wage differences for observationally equivalent workers across industries, commonly referred to as inter-industry wage differentials, is well documented, and is largely held as one of the least understood aspects of the employment relationship. Accounting for 15% of observed wage inequality, its importance should not be underestimated.

Accordingly, this study provides further evidence into the sources of these wage differentials. Specifically, the influence of international trade is investigated. Recent studies

by Dickens and Lang (1987) and Katz and Summers (1989) have noted specific correlations between the extent of trade activity in an industry and wage differentials. Their finding is that imports tend to be more prevalent in industries with low-wage premia while industries paying larger wage premia tend to export more. Neither study, however, investigates the relationship thoroughly. Gaston and Trefler (1991) provide an interesting analysis of the relationship, including comprehensive measures of industry protection. Absent from this study, however, is consideration of alternative sources of these wage differentials. The effects of international trade are thus assessed in the absence of controls for these other relationships. While these studies highlight a correlation, a causal link has yet to be established.

The objectives of this study are two-fold. The primary objective is to assess the relationship that exists between changes in international competition and the industrial structure of wages in the United States; *i.e.*, the pattern of wage differences across industries. The sources of these differentials are fundamentally determined within the industry while not substantially influencing other sectors of the economy; hence, the analysis can be undertaken in a partial equilibrium framework. The secondary objective is to relate the changes in industry differentials arising from changing trade patterns with changes in the observed distribution of earnings. Recent years have witnessed a substantial increase in the earnings of skilled workers *vis a vis* those of unskilled workers. The expectation is that changes in international competition have served to exacerbate this trend through their influence on wage differentials.

It is primarily manufacturing industries that exhibit significant wage premia and workers in manufacturing sectors tend to be unskilled. Increases in international competition that serve to reduce the wage premia in manufacturing serve to reduce the earnings of low-skilled workers in two ways. First, because the rents of domestic firms are lowered as international competition increases, the wages of workers remaining in those industries decline. Second, to the extent that foreign competition leads to lower employment lev-

els in these concentrated industries, many of the workers must move to the lower paying competitive sectors of the economy. Overall, the wages of less educated workers will fall relative to those of college educated workers.[1] It is only the first of these influences that is addressed in this study, however.

The study is based on the following presumptions; first, that of a link between international competitiveness and industry profitability. This is an assumption that is largely consistent with predictions of the "new" trade theory, and one that has been, to some degree, empirically verified.[2] The second assumption is that of a relationship between industry profitability and industry wages. This connection is less well documented; previous research has, for reasons discussed below, focused on industry concentration rather than profitability and the results of these studies are mixed; earlier research found no significant connection between concentration and wages, while later studies report small but statistically significant positive effects.[3]

There is reason to believe that studies of the influence of import competition on observed industry profitability will generate results that are biased downward. The reasoning lies in the distinction between the *observed* profitability of an industry and the *actual* or *potential* profitability of an industry. Observed profitability, measured as the price-cost margin, can differ from actual profitability through the existence of "monopoly rent-sharing" in the industry. To the extent that import competition results in a reduction of rents paid to labor, rather than a reduction in observed profitability, the effects of international competition will be understated.

There is further reason to believe that studies measuring the impact of concentration on wages will mis-state the relationship when ignoring the role played by international competition. It is possible that domestic concentration of production could increase in the face of foreign competition while actual industry profitability declines. Such an effect

[1] Borjas and Ramey (1992) present a partial analysis and empirical test of this hypothesis.

[2] See Pagoulatos and Sorensen (1976), who find that foreign factors represent a fruitful addition to conventional domestic structure variables in explaining inter-industry differences in price-cost margins. See also Pugel (1980) and Nolle (1991).

[3] Weiss(1966), Belman(1988), and Kwoka(1983)

would serve to weaken the link between industry concentration and observed differences in industry wages.

The paper proceeds as follows. Section II presents a brief discussion of alternative sources of inter–industry wage differentials. The methodology employed in this study is presented in Section III, while results are found in Section IV and general conclusions are discussed in Section V.

II. Inter-Industry Wage Differentials

Inter-industry wage differentials are differences in wages paid to observationally equivalent workers in different industries. The existence of these industry differences is well documented.[4] The explanations for these industry differences however are roughly as large in number as are the studies documenting their existence. These explanations can be substantially covered by identifying three broad categories: compensating wage differentials, the payment of efficiency wages, and rent-sharing.[5] Compensating wage differentials are differences in wages that arise because of some basic difference in the work environment within one industry relative to all other industries. Efficiency wage theories center around the idea that increasing workers wages above the market rate will have a positive influence on profits, possibly through reducing the incidence of turnover, raising the effort of workers, or by increasing the quality of the applicant pool. Finally, managers may find it in their best interest to allocate some share of the rents to providers of factor inputs.

The first and second explanations have been largely discredited as primary determinants of inter-industry wage differentials. Krueger and Summers, using the Michigan Quality of Employment Survey, find limited evidence of compensating wage differentials.

[4] Krueger and Summers (1988) provide a detailed econometric accounting and test of various reasons for their existence. Other authors have also documented their existence and stability over time, for example, Slichter (1950).

[5] It has also been suggested that unobserved quality differences might account for some part of the differentials. Krueger and Summers present compelling evidence that this is not the case.

Capelli and Chauvin (1991) find that the payment of efficiency wages would imply the expenditure of roughly $2 million/year, or $121,000 per shirking-related disciplinary action, at a representative firm with 1000 workers, to explain the measured differentials. This would seem an implausibly expensive means of reducing shirking.

It is the last of these explanations that forms the basis for this study. The rent-sharing or "monopoly-wage hypothesis" is the idea that workers in concentrated industries secure higher wages as a result of the larger profits to be shared or the greater ability of firms to pass on cost increases to consumers. The sharing of rents with workers in the industry can be explained as a way of encouraging worker loyalty. This is but one explanation, one that might be listed under the efficiency wage theories. Alternative explanations of rent-sharing might include paying higher wages in an effort to maintain a good public image,[6] or that firms may possess a limit-profitability, that is, a level of observed profits above which potential entrants may realize their potential and enter the market. Incumbent firms will then use any excess profits to improve the lot of their workers and other producers/suppliers of factors of production.

III. Methodology

The primary motivation of this study is to assess the impact of trade driven changes in inter-industry wage differentials on the earnings distribution. The analysis will be carried out in a three stage process. The first stage consists of generating a time series of cross-sectional data on inter-industry wage differentials. In the second stage, the source of the inter-industry wage differentials will be investigated. There exists an extensive literature that has determined the industry characteristics that are likely sources of wage differentials; these include plant size, industry concentration, and unionization rates. A cross-product term between concentration and unionization has also been found to be important for disentangling the related effects of unionization and concentration (Kwoka (1983)). In

[6] See Weiss (1966) for an elaboration of this hypothesis.

addition, this study adds data on trade volumes: import penetration ratios and exports as a share of domestic production.

The third step is then to examine the impact of observed changes in trading patterns on the distribution of earnings. This consists of calculating the difference between the observed wage premia and those that would have prevailed in the absence of changes in trade competition. The change in wage premia will then be correlated with the distribution and type of workers in each industry.

Wage Differentials

The approach taken here is to focus on the differences in compensation between industries, rather than on the *level* of compensation in different industries. These differentials are calculated as the coefficients on industry dummies in the following standard wage equation:

$$ln(w_{ij}) = \beta X_{ij} + \delta D_j + \epsilon_{ij}, \qquad i = 1, ..., n_j, \quad j = 1, ..., I. \quad (1)$$

Where X_{ij} is a vector of individual specific characteristics and D_j is an industry dummy variable. The δ_j are then the payments to workers in industry j above those due to their individual-specific characteristics. The wage and other individual specific data is from a time series of March Current Population Survey computer tapes spanning 1979 through 1985. The classification of industries is according to the three digit Census Industry Classification (CIC) scheme.[7,8] As alluded to above, we are measuring industry compensation rather than wages alone. That is, the wage recorded in the CPS is inflated so as to reflect total expenditures on labor, rather than payroll, as reported in the Annual Survey of Manufacturers. What is truly being investigated are, therefore, inter-industry compensation differentials.

[7] This classification corresponds to a combination of 2- and 3- digit Standard Industrial Codes.

[8] A more thorough presentation of the methodology is contained in a data appendix available from the author.

Sources of Compensation Differentials

The framework in which to think about these compensation differences is as follows. In any given industry, j, the workers receive a fraction of industry rents. Compensation is then determined as follows:

$$w_{ji} = w_i \cdot (1 + \delta_j), \tag{2}$$

where i represents an individual with a given set of characteristics, and δ_j represents the supra-normal rents obtained by working in industry j. In the above, w_{ji} is observed compensation and w_i is the market compensation for a worker with characteristics i. Expenditures on labor can then be specified as:

$$(1 + \delta_j) \cdot \sum_{i=1}^{n_j} w_i = \alpha_j \cdot RENTS_j, \tag{3}$$

where n_j is the number of employees in industry j. In this framework, α_j and $RENTS_j$ are independently determined.[9] The rents in industry j are determined by characteristics of the output market, while the share of these rents going to labor, α_j, are determined internally to the firm. The remaining rents are allocated across other expenditure categories. These categories include producers of capital and other inputs, shareholders, and other expenditure categories not related to the production process, such as research and development (R&D) or advertising.

Rearranging (3) we find that

$$(1 + \delta_j) = \frac{\alpha_j \cdot RENTS_j}{\sum_i w_i}.$$

Taking logarithms of the latter and utilizing the fact that, for small δ_j, $\ln(1 + \delta_j) \approx \delta_j$, we have

$$\delta_j = \ln(\alpha_j) + \ln(RENTS_j) - \ln(\Sigma_i w_i),$$

where

[9] It need not be the case that α_j and $RENTS_j$ are independent. If managers wish to provide their shareholders with a particular rate of return, it is possible that labor's share of rents could decline with rents.

$$\ln(\alpha_j) = \gamma Z_1 + \epsilon_1$$

and

$$\ln(RENTS_j) = \rho Z_2 + \epsilon_2.$$

Z_1 and Z_2 are then vectors of industry characteristics determining the fraction of rents accruing to labor and the volume of rents available, respectively. The estimating equation is then of the following form:

$$\delta_{j,t} = \beta + \gamma Z_{1,t} + \rho Z_{2,t} + \eta,$$

where $\eta = \epsilon_1 + \epsilon_2$ and is assumed to be distributed normally, with mean zero. The $\eta_{j,t}$ are, however, heteroskedastic. The heteroskedasticity arises from the fact that the $\delta_{j,t}$ are coefficients from the first stage regression and are estimated with a particular error variance. The Generalized Least Squares method, weighting each observation by $1/\sigma$, where σ is the standard error of the estimated $\hat{\delta}$ from equation (1), is used to estimate the above relationship.

Counterfactual

The counterfactual analysis of this study involves the calculation of the wage differentials had there been no change in trading patterns over the time period, that is, had trade not changed in level of importance for the domestic industry. Crucial to the analysis is the conceptual development of values for the trade variables that represent neutral changes in trading patterns. Import penetration ratios and exports as a fraction of domestic production were used to indicate the level and nature of international competition in each industry. Consequently, it is necessary to specify what it means to maintain the 1978 level of importance of international trade throughout the time period.

With respect to the trade variables, had we been using simple exports and imports, this would be a difficult issue. Problems concerning the rate of growth of the domestic market would complicate matters. Given the variables used, however, simply fitting values

of the wage differentials given zero values for the difference in import penetration and export share variables accomplishes this.

IV. Regression Results

This section launches the investigation into the sources of inter-industry wage differentials. As a rough test of the data, and in order to develop some insight into the results obtained in the inter-industry wage differential regressions, Column 1 of Table 1 presents results from a now standard industry profitability regression. Overall, the results presented here conform very well with previously published studies. Industry concentration, capital, advertising, and R&D expenditures each exert a positive influence on profitability, while a higher degree of unionization is found to reduce profitability.

Column 2, however, utilizes an alternative definition of industry profitability as the dependent variable. The traditional measure first presented by Collins and Preston (1969), is calculated as:

$$Rents = \frac{ValueAdded - Payroll}{Shipments}.$$

Under the operative rent-sharing hypothesis, this presents a potentially dramatic misspecification of industry rents. This measure has the undesirable property of attributing rents shared with labor to costs, biasing measured industry rents downward.

The alternative definition of industry rent attributes the fraction of compensation that is supra-market to value added, rather than to costs. The formula is as follows:

$$AllRents = \frac{\left[ValueAdded + \frac{\delta \cdot Payroll}{(1+\delta)}\right] - \frac{Payroll}{(1+\delta)}}{Shipments}.$$

This may also be a poor indicator of industry profitability; if the estimated wage premia, δ, represent efficiency wages or compensating differentials then they are properly attributable to costs and removing them from payments to labor will cause this statistic to be biased high. The results from Column 1 are largely robust to this alternative measure of rents.

Table 1
Rents Regressions
(Standard Errors in Parentheses)

Variable	Rents	AllRents
CONSTANT	-0.029	-0.007
	(0.030)	(0.022)
IPR	-0.126**	-0.099 **
	(0.060)	(0.044)
EPR	0.149*	0.194 ***
	(0.078)	(0.057)
CR4	0.155***	0.157 ***
	(0.046)	(0.034)
UNPER	-0.128*	0.006
	(0.072)	(0.052)
ESTSZE	-0.097	0.117 **
	(0.068)	(0.049)
U*CR4	-0.503***	-0.333 ***
	(0.139)	(0.102)
KOUT	1.362***	1.380 ***
	(0.079)	(0.057)
ADVOUT	2.834***	2.254 ***
	(0.206)	(0.150)
RDOUT	0.465	0.600 ***
	(0.296)	(0.216)
R^2	0.613	0.690
N	392	392

***, **, * Significantly different from zero at the 1, 5, and 10%.

Several findings are worthy of note at this point. First, the coefficients on the international trade variables are precisely as one would expect. An increase in the share of imports in domestic sales (IPR) results in a reduction in industry profitability, whereas an increase in the fraction of domestic production that is shipped abroad (EPR) – a reflection of an enhanced competitive position *vis a vis* foreign competition – enhances industry profitability. The effect is stronger for exports in both specifications, perhaps reflecting what I call the large market syndrome: US exporters, given the large size of their primary market, appear to be less likely to search out additional markets than are

foreign producers. Hence, the extent to which they do is reflective of their participation in only the most profitable markets.

The coefficient on the percent unionized variable (UNPER) provides some insight into the rent-sharing hypothesis. When some fraction of labor compensation is included in rents rather than costs, the percent unionized variable is no longer significant. One might be tempted to accept this as evidence of the super-efficiency of unions, that is, unions have no impact on rents, merely on their distribution. This notion is quickly dispelled when one notices the coefficient on the cross-product term between union activity and concentration (CR4). Unionization does seem to lower the level of profitability of more concentrated industries. The average establishment size (ESTSZE) enters the regression in column 1 with an unexpected negative sign. This result is reversed, however, when rents are accurately measured, supporting the notion that larger firms tend to be more efficient than smaller firms.

We turn now to estimating the source of the industry wage differentials. The regression specification consists of two sets of variables, Z_1 and Z_2, those determining labor's share of overall rents and the available rents, respectively. Studies identifying Z_2 are plentiful. Unfortunately, constructing a time series of these variables on a disaggregated level is very difficult. Hence, we will only use a subset of those variables identified as influencing industry profitability.[10] To my knowledge, the variables appropriately included in Z_1 have not been previously specified. The estimated regression will include in Z_1 variables reflective of the categories across which any rents might be distributed.

The set of variables Z_1 include K/L, the ratio of capital expenditures to labor expenditures. If managers are distributing rents across capital and labor, then the lower are expenditures on capital relative to labor, the higher will be labors share of industry rents. The percent unionized, UNPER and U*CR4, also belong in Z_1. A larger union presence should bias the distribution of rents towards labor. Finally, the ratios of advertising and

[10] These are the variables in Table 1.

research and development (R&D) to output, ADVOUT and RDOUT, are also expected to influence labors share of the rents. That is, managers already making significant expenditures on advertising and R&D may be inclined to increase those expenditures, reducing labors share.

The sets of explanatory variables, Z_1 and Z_2, turn out to overlap. The percent unionized, for instance, is a member of both groups, as are expenditures on advertising and R&D. Interpretation of the estimated coefficients will therefore be difficult. The magnitude of the coefficients will not be meaningful, however, the sign will provide some insight into the relative strengths of the separate influences should they push in opposite directions; advertising and R&D, for example, are indicative of larger overall rents, but are expected to reduce labor's share of those rents. If their respective coefficients are negative, this can be interpreted as their having a more significant impact on α_j than on $RENTS_j$.

The issue of specific interest is the influence of changing trade patterns on the partial equilibrium wage premia received by workers in particular industries. These trade variables are not thought to exert influence over labor's share of rents, but rather over the availability of rents.[11]

Table 2 presents the results of regressions attempting to explain the determinants of inter-industry wage differentials (IIWD). Two alternative specifications are presented. Columns 1 and 2 include a single intercept term, while columns 3 and 4 control for industry fixed effects by including separate dummy variables for each of the 56 industries. The fixed effects model is estimated as an attempt to control for hypotheses competing with rent-sharing. Specifically, the incidence of compensating wage differentials and efficiency wage payments are likely to differ systematically, cross industries. The time period is short enough, however, to permit the assertion of a stable inter-industry relationship.

A striking feature of the results is their remarkable stability across specifications. Given that some of the explanatory variables are likely to be indicators of efficiency wages

[11] Although the automobile industry provides a glaring counterexample, this event is not representative of the general relationship between labor and management.

Table 2
Regression Coefficients - IIWD
With Industry Fixed Effects
(Standard Errors in Parentheses)

	Common Intercept		Ind. Fixed Effects	
CONSTANT	−0.099 *** (0.032)	−0.131 *** (0.090)		
Variables Determining the Level of Profits (Z_2)				
IPR	−0.295 *** (0.056)	0.019 (0.090)	−0.348 *** (0.059)	−0.089 (0.094)
EPR	0.531 *** (0.085)	0.446 *** (0.140)	0.514 *** (0.095)	0.202 (0.151)
IPR*CR4		−1.033 *** (0.238)		−0.917 *** (0.266)
EPR*CR4		0.179 (0.300)		0.814 ** (0.341)
CR4	−0.078 (0.050)	0.030 (0.063)	−0.168 *** (0.045)	−0.145 *** (0.051)
ESTSZE	0.532 *** (0.076)	0.495 *** (0.075)	0.588 *** (0.087)	0.569 *** (0.085)
KOUT	−0.044 (0.127)	−0.041 (0.114)	−0.032 (0.105)	−0.014 (0.105)
Variables determining Labor's Share of Profits (Z_1)				
K/L	−0.048 *** (0.011)	−0.049 *** (0.011)	−0.059 *** (0.014)	−0.065 *** (0.014)
UNPER	0.244 *** (0.081)	0.276 *** (0.080)	0.050 (0.063)	0.065 (0.065)
Variables in Both Z_1 and Z_2				
U*CR4	0.346 ** (0.157)	0.292 * (0.154)	0.616 *** (0.150)	0.597 *** (0.149)
ADVOUT	−0.340 (0.259)	−0.704 *** (0.267)	−0.511 * (0.265)	−0.767 *** (0.287)
RDOUT	−1.053 *** (0.220)	−0.686 *** (0.237)	−1.222 *** (0.236)	−0.982 *** (0.263)
R^2	0.659	0.675	0.710	0.722
N	392	392	392	392

***, **, * Significantly different from zero at the 1, 5, and 10%.

or compensating differentials, one might expect their coefficients to decline significantly in absolute size when the industry dummies are included. In particular, it could reasonably be suggested that a larger establishment size, or a higher capital-labor ratio, might plausibly

result in efficiency wage differentials, or that the latter might result in positive compensating differentials. Most of the estimated coefficients are nonetheless very robust across specifications. Curiously, however, the percent unionized becomes unimportant when the industry dummies are included. Further investigation reveals that the individual industry unionization rates do not fluctuate significantly during this period and are hence highly correlated with the industry dummies.

The results do tend to support the rent-sharing hypothesis. Higher expenditures on capital (relative to labor), advertising, and R&D all tend to reduce labor income. Industry concentration (CR4) is curiously negative. However, the cross-product between CR4 and the percent unionized is positive and significant, suggesting that organized labor's ability to raise wages is indeed correlated with industry concentration.

Whether or not industry fixed effects are included, a significant ability of international trade to influence labor's income is indicated. Focusing on the fixed effects model, it is apparent that a larger presence of foreign supply in the domestic market reduces labor income, while an expansion of exports provides an even greater boost to labor. As a further check of the rent-sharing hypothesis, column 4 includes the trade variables crossed with the concentration ratio. Doing so reduces the significance of the raw trade variables, but highlights the relationship with profitability. The more highly concentrated is the industry, the larger is the impact of international trade on labor earnings.

Although the results for the trade variables are strong statistically, their economic significance may reasonably be questioned. The calculated elasticities for imports and exports are between .06 and .1 in absolute value. However, the calculated elasticity for concentration is of the same order of magnitude. To the extent that one argues concentration is important, one would argue that international trade is equally important.

V. Wage Differentials and Inequality

Recent trends in earnings inequality include significant increases in within group inequality. That is, the incidence of observationally equivalent workers making dramatically different wages is increasing.[12] There are several different suggestions for why this might be so, ranging from increased variance in the quality of observed educational levels, to changing wage-setting institutions, and increasing returns to skill. Changes in inter-industry wage differentials is yet another possible explanation. The evidence regarding inter-industry wage differentials and inequality is quite lean, however. Blackburn (1990), also using CPS data, shows that approximately 15 percent of the increase in within-group variation in earned income for men results from the movement of workers from industries in which the residual variation in earned income is relatively low to industries in which the residual variation is relatively high. Dickens and Katz (1987) provide further evidence that industry-specific differentials explain approximately 15 percent of residual earnings variation in a cross-section.

Table 3 provides an indication of the role played by wage differentials in generating inequality within the sample used here. The data in the columns labelled "Actual" and "No ΔTrade" are based on the observed wage differentials and the counterfactual differentials, respectively. In other words, the "Actual" column is how the world is, while the "No ΔTrade" column is how the world would have been, but for the changes in international competition experienced throughout the period. The first row indicates the extent of variation in wage differentials within an industry over time and is an average across industries. The second row indicates the variation across industries and is an average over time. Not surprisingly, the average within industry variation is significantly smaller than the across industry variation. It is this latter variation that is specifically under investigation. We also find that the variation within manufacturing industries is lower than for the economy as a whole.

[12] See Levy and Murnane (1992) for an excellent review of this literature.

Table 3
Standard Deviations of Wage Differentials

	All Industries		Manufacturing	
	Actual	No ΔTrade	Actual	No ΔTrade
Within Industries	.091	.098	.085	.099
Across Industries	.200	.206	.155	.174

From this table, evidence of the influence of changing trade patterns on inequality is apparent. The second and fourth columns indicate the degree of variance in all industries and manufacturing, respectively. Looking first at manufacturing industries, we find striking results both in terms of the magnitude of change and the direction. What we learn is that both within and across industry variation in wages are approximately 10% lower than they would have been in the absence of changing international competition. The same tendency holds for all industries, but the effect is smaller.

In terms of the *a priori* intuition, these results are counterintuitive. If one stops to consider the time period, however, the results are not so surprising. During this period, imports increased dramatically, with no corresponding increase in exports. In fact, while the mean import penetration ratio increased from 8.2% to 11.9%, production for export fell from 9.2% to 7.1%. The net result is a decline in the premia paid in 42 of the 56 industries. With manufacturing industries generally paying the largest premia, the result is reduced overall variation in the observed differentials.

As for earnings inequality more generally, Table 4 presents annual Gini coefficients for all industries in columns 2 and 3 and for the manufacturing sector alone in columns 4 and 5. Again, a counterfactual level of inequality is juxtaposed the observed level of inequality. The "Actual" and "No ΔTrade" columns are analogous to those in Table 3. The Actual Gini coefficients are based on the micro-data from which the $\hat{\delta}$s were

Table 4
Gini Coefficients

	All Industries		Manufacturing	
Year	Actual	No ΔTrade	Actual	No ΔTrade
78	0.323	0.323	0.291	0.291
79	0.324	0.325	0.285	0.286
80	0.320	0.321	0.277	0.278
81	0.322	0.323	0.283	0.285
82	0.329	0.330	0.290	0.293
83	0.337	0.336	0.299	0.302
84	0.334	0.333	0.298	0.305
85	0.338	0.338	0.304	0.312

estimated. The No ΔTrade gini's are calculated by altering the micro-data in such a way as to account for the accumulated effects of changing international trade patterns. That is, the 1978 No ΔTrade Gini is equal to the Actual 1978 Gini, while the 1979 No ΔTrade Gini is equal to the Actual 1979 Gini plus the industry by industry changes in fitted inter-industry wage differentials imposing neutral international competition. The No ΔTrade gini's for subsequent years are calculated analogously, imposing the 1978 level of international competition. The differences between column 2 and 3 and the differences between columns 4 and 5 in 1985, therefore, represent the accumulated effect of changing trade patterns.

Once again, we find that over time, changing trade patterns have served to *reduce* earnings inequality. In manufacturing industries, international forces reduce the Gini coefficient by three percent. While this might seem a rather small change, the overall impact on the Gini coefficient of removing the wage differentials entirely is to reduce inequality by approximately eight percent. International trade then served to reduce the earnings inequality stemming from wage differential by nearly one half.

Table 5
Wage Changes

	Hourly Compensation			% Change Due to:	
	Observed	No ΔTrade	% Change	Imports	Exports
By Occupation:					
1	8.08	8.12	−0.53	−0.05	−0.49
2	11.10	11.31	−2.04	−1.27	−0.77
3	8.97	9.17	−2.32	−1.66	−0.66
4	9.43	9.62	−2.41	−1.82	−0.59
5	11.56	11.81	−2.11	−1.69	−0.42
6	13.08	13.35	−2.05	−1.22	−0.83
7	10.31	10.54	−2.20	−1.27	−0.94
8	14.96	15.28	−1.80	−0.97	−0.83
9	19.02	19.42	−2.17	−1.11	−1.07
10	16.61	17.09	−2.77	−0.86	−1.91
By Education Level:					
< 12 Years	9.13	9.18	−2.39	−1.83	−0.57
High School	11.52	11.62	−2.15	−1.42	−0.73
Some College	12.93	13.09	−2.26	−1.11	−1.15
College Grad	18.91	19.19	−2.52	−1.03	−1.50

The influence on the economy as a whole is much less significant. While the tendency was to reduce inequality throughout the period, the Gini coefficient controlling for changes in trade patterns ends up roughly equal to the observed Gini coefficient in 1985, just as it was assumed to in 1978. Given that the manufacturing sector accounted for only 25% of employment during this period, this significant difference is not entirely surprising.

The effect on manufacturing is, however, surprising and warrants further investigation. Table 5 thus presents the impact of changing trade patterns on the wages of variously skilled workers. Column 1 contains the observed level of hourly compensation in 1985, while the second column presents the levels of compensation that would have been

paid but for the change in international competitiveness. Columns 3 through 5 display the overall percent change in wages, the change due to fluctuations in import competitiveness, and due to export competitiveness, respectively.

The upper portion of Table 5 presents the impact on wages by occupation. The occupations are ordered by increasing educational demand. That is, the average worker in occupation 10 (professional, technical and kindred workers) has obtained more schooling that the average worker in occupation 1 (farming, forestry, and fishing occupations). From these occupational statistics, it becomes clear that the impact across skill levels is roughly uniform. Breaking it out into the impact of imports and exports separately, it appears as though imports have a more substantial impact on lower skill occupations while exports tend to impact the more skilled workers.

The lower portion of Table 5 illustrates this pattern of influence with more clarity. The impact of changes in imports declines monotonically with education, while the impact of changes in export competition is monotonically increasing with skill level. Although the influence on overall inequality is surprising, the underlying influence on wages very much conforms to our *a priori* expectations. That is, as import competing industries go, so go the fortunes of the unskilled; as the export competing industries go, so go the fortunes of the skilled.

VI. Conclusions

The primary contribution of this research is to provide a new approach to an old problem. Using changes in international competitiveness removes a bias inherent in the prior analyses of the relationship between industry profitability and wages, that of the immeasurability of actual or potential industry profits.

Additionally, the individual level data used in the construction of the dependent variable permits an analysis of one avenue through which trade has an impact on the earnings distribution in the United States. If there is a systematic bias in the type of

worker, perhaps skilled versus low-skilled, that receive the wage premia, then, to the extent that import competition serves to reduce inter-industry wage differentials, it will also serve to reduce the earnings of those receiving a wage premium relative to those that do not. *A priori*, one might expect that it is low skilled workers that receive the wage premia and hence that trade will serve to exacerbate the disparity of earnings in the United States.

Ex post, however, what we find is that changes in trade patterns in the early 1980s altered industry wages differentials so as to *reduce* observed earnings inequality. The sizeable trade imbalance developed at the beginning of the decade resulted in many industries being subject to substantial increases in competition from abroad. The end result appears to have been a depressing of wages in the manufacturing sectors. Given that manufacturing sectors pay above average wages, the result was a compression of the earnings distribution.

It should be noted, however, that this result pertains to but one avenue through which international competitiveness can influence the earnings distribution. There is nothing in the analysis that addresses intersectoral employment flows due to international trade and hence there is no attempt to address Stolper-Samuelson type general equilibrium wage effects. The conclusion of this study, then, is that in a period of increasing within group inequality, changes in international competitiveness appear to have reduced within group inequality relative to what would have otherwise been observed.

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APPENDIX A

DESCRIPTION OF VARIABLES

Table A.1

Description of Variables

Variable	Mean*	Description
RENTS	0.249	Industry rents as per Collins and Preston (1969).
ALLRENTS	0.358	Industry rents labelling wage differentials as rents.
IPR	0.094	Import Penetration Ratio: $\frac{Imports}{DomesticSales}$.
EPR	0.086	Export share of domestic production: $\frac{Exports}{DomesticProduction}$.
CR4	0.437	4-firm Concentration ratio.
*IPR*CR4*	0.037	Crossproduct of IPR and CR4.
*EPR*CR4*	0.037	Crossproduct of EPR and CR4.
UNPER	0.301	Percent of industry labor force covered by a union contract.
*U*CR4*	0.135	Crossproduct of UNPER and CR4.
ESTSZE	0.105	Average industry establishment size.
K/L	0.997	Capital expenditures relative to payroll.
KOUT	0.191	Capital expenditures as a fraction of industry sales.
ADVOUT	0.021	Advertising expenditures as a fraction of industry sales.
RDOUT	0.016	R&D expenditures as a fraction of industry sales.

*Means are for manufacturing industries during the years 1979 through 1985.

APPENDIX B

DATA

The data on wages and individual worker characteristics are from a time series of March Current Population Survey (CPS) data tapes spanning 1979 through 1985. The sample of observations is limited to those individuals in the outgoing rotation group.[13] While this reduces the size of the sample in each year, it also eliminates an explicit source of temporal correlation in the calculated wage differentials. That is, an individual observation is only included in the calculation of one years wage differential.

In addition to the 55 industry dummies (plus the omitted industry gives 56) the control variables included in the wage regression are the following: 8 region and 9 occupation dummy variables, education, marital status, race, age, sex, central city dummy, and the following cross-product terms: education-sex, education^2-sex, age-sex, marital status-sex.

The international trade, production, unionization, and employment data are from the NBER Trade dataset, the NBER Productivity Database, and the NBER Manufacturing Sector Master File. These data come in the 4 digit SIC classification and are subsequently concorded to a slightly aggregated version of the Census Industry Classification used in the CPS datasets. Limiting our observations to manufacturing industries, we have data for a total of 56 traded industries over a seven year time series.

The following table provides further information regarding the data sources.

[13] Individuals in the CPS sample are interviewed for eight months; each household is interviewed for four consecutive months (the incoming rotation) and then falls out of the rotation for eight months and then is interviewed in each of four more consecutive months (the outgoing rotation). The consequence of this is that some individuals will be present in both the year t March CPS and the year $t+1$ CPS.

Table B.1

Data Sources

Variable	Description
Capital	(ASM) real capital stock (plant+equipment).
Union	Percent of all workers unionized. 1974 values estimated from 1973,74,75 May CPS; 1958-73 values also contain this estimate. 1980 values estimated from 79,80,81 May CPS; 1983, 84 and 85 values are from Hirsch and MacPherson (1993). Estimates for intervening years obtained by interpolating linearly.
Payroll	(ASM) annual payroll.
Output	(ASM) value of industry shipments.
Imports *Exports*	Import and export data for 1972-85 from the BLS trade monitoring system. Data for 1958-71 obtained by using the BLS method for import/export classification and adjusting shipment data. Raw data for this period from Census Bureau publication, "US Commodity Exports and Imports as Related to Output."
Estsze	(CM) average employment per establishment.
Vadd	(ASM) value added by manufacture (equals shipments - materials + inventory change).
CR4	4-firm Concentration ratio. Calculated using data from the NBER Productivity Database as described in Hall (1990). The index is calculated by dividing the output of the largest four firms in this database by the above output variable for each industry and year.
Advertising	Advertising expenditures as a fraction of industry sales. Where industry sales is defined as sales from firms present in Hall (1990).
R&D	R&D expenditures as a fraction of industry sales. Where industry sales is defined as sales from firms present in Hall (1990).

ASM: Annual Survey of Manufactures. CM: Census of Manufactures.

APPENDIX C

INDUSTRY DEFINITIONS

Number	Description
1	Meat products
2	Dairy products
3	Canned, frozen and preserved fruits and vetgetables
4	Grain mill products
5	Bakery products
6	Beverage industry
7	Sugar confectionery products
8	Food industries n.e.c.
9	Tobacco manufactures
10	Knitting mills
11	Dyeing and finishing textiles, except wool and knit goods
12	Yarn, thread, and Misc. textile mill products
13	Apparel and access., except knit
14	Misc. fabricated textile products
15	Pulp, paper, and paperboard mills
16	Misc. paper and pulp products
17	Newspaper publishing and printing
18	Printing, publishing, and allied industries, ex. newspapers
19	Plastics, synthetics, resins and chemicals
20	Drugs
21	Soaps and cosmetics
22	Misc. Chemicals and Allied Products.
23	Petroleum refining and Misc. petroleum and coal products
24	Tires, plastic footwear, belting, and other rubber products
25	Misc. plastic products
26	Leather and Leather products
27	Logging
28	Sawmills, planing mills, and millwork
29	Wood buildings and mobile homes and Misc. wood products
30	Furniture and fixtures
31	Stone, Clay, Glass and Concrete Products
32	Balst furnaces, steelworks, finish mills
33	Iron and steel foundries
34	Primary aluminum industries
35	Other primary metal industries
36	Cutlery, handtools, and general hardware
37	Fabricated structural metal products
38	Misc. fabricated metal products
39	Metal forgings, stampings and Ordnance
40	Engines and turbines
41	Farm machinery and equipment
42	Construction and material handling machines
43	Metalworking machinery
44	Computers and related equipment
45	Machinery, exc. electrical, n.e.c.
46	Household appliances
47	Radio, TV, and communication equipment
48	Electrical machinery, equipment, and supplies n.e.c.
49	Motor vehicles and equipment
50	Aircraft and parts
51	Railroad, Ship and boat building and reparing
52	Cycles and misc. transportation equipment
53	Scientific and controlling instruments
54	Medical, dental, and optical instruments and supplies
55	Photographicand timekeeping equipment and supplies
56	Manufacturing industries n.e.c.

APPENDIX D

OCCUPATIONS

Table D.1

Occupation Codes*

(Ordered by educational requirement – lowest to highest)

Number	Description
1	Farming, Forestry, and Fishing Occupations
2	Service occupations
3	Nonfarm laborers
4	Machine Operators, Assemblers, and Inspectors
5	Transportation and Material Moving Equipment Occupations
6	Precision production, craft, and repair occupations
7	Administrative support occupations, Including Clerical
8	Sales workers
9	Executive, administrative, and managerial occupations
10	Professional, technical and kindred workers

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